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Report of the

TWENTY-FIRST SOUTHERN PASTURE AND FORAGE CROP

IMPROVEMENT CONFERENCE

University of Florida
Gainesville, Florida

April 22-23, 1964

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Crops Research Division

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Report of the
TWENTY-FIRST SOUTHERN PASTURE AND FORAGE CROP
IMPROVEMENT CONFERENCE^{1/}

University of Florida
Gainesville, Florida

PROGRAM

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^{1/} Reported by: D. E. McCloud, Permanent Secretary, USDA, Beltsville,
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Thursday - April 23 - Afternoon

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Wednesday - April 22 - Morning

O. Charles Ruelke, Presiding

Opening Session

The twenty-first meeting of the Southern Pasture and Forage Crop Improvement Conference was officially opened by Conference Chairman, Dr. O. C. Ruelke. In reminiscence, Chairman Ruelke pointed out that the Southern Pasture and Forage Crop Improvement Conference has a long history in the South, dating to the first meeting at Tifton, Georgia, July 23-24, 1940. He told the group that the first Conference Chairman, Dr. R. L. Lovvorn is with us in today's meeting. Chairman Ruelke said that the primary objective of the Southern Pasture and Forage Crop Improvement Conference, "To encourage the cooperation of all groups that are in a position to contribute to the pasture and forage crop improvement program," is still as valid today as it was almost a quarter of a century ago.

Chairman Ruelke introduced the members by states. Members attending are:

Alabama	14	Louisiana	5	Oregon	1
Arkansas	2	Maryland	2	So. Carolina	2
Florida	28	Mississippi	4	Tennessee	4
Georgia	23	No. Carolina	5	Texas	8
Kentucky	8	Oklahoma	4	Washington, D.C.	5

Chairman Ruelke introduced Dr. E. T. York, Jr., Provost for Agriculture, to welcome the group to Florida. Provost York said "As I look at this audience it seems like old home week. I see classmates, professors, students, and friends, so it is a real pleasure to be here to see and visit with so many old friends." Provost York indicated he has been impressed with the contribution of this group which is responsible for many of the developments of the livestock industry in the South. Provost York emphasized the significance of the fact that more than 50 percent of the original founding committee of the Southern Pasture and Forage Crop Improvement Conference is here today, which is indicative of the continuing interest and the contributions of this group. Provost York apologetically noted that it is customary for one in this position to do a little bragging about the agriculture of the host State. Florida's agriculture is extremely diverse and it is growing very rapidly. Since 1940, milk production in Florida has increased 346 percent compared to an increase of 19 percent for the U. S. as a whole during the same period. Similarly, livestock production is up 900 percent in Florida compared to an increase of 331 percent for the U. S. as a whole. This indicates the rapidity with which Florida's agriculture is growing and indicates great promise for the future. Provost York stressed the need for interdisciplinary approaches to the complex problems of forage and livestock production in the South. He indicated that Florida is currently engaged in over-all study of the agricultural program for the State. He stressed that agriculture is constantly expanding to meet the needs of a constantly growing population and an expanding economy. Provost York extended his welcome and his thanks for coming, and the hope that this meeting will be profitable to all participants.

The Team Approach Toward Research - H. H. Wilkowske, Assistant Director,
Florida Agricultural Experiment Station.*

From the staff and administration of the Experiment Stations let me add our welcome to Florida to you. We certainly hope you enjoy your stay, have a successful meeting, learn a lot of new information, and also soak up a little sunshine, enjoy some fresh orange juice, and especially obtain a fair amount of dither. That's spelled D I T H E R, which requires an explanation.

When working, early in World War II, on antiaircraft computing and gun aiming devices, the British scientists came up with a rather unique device they called a "dither". To overcome the external interference from air turbulence and other disturbances, they reasoned that if they included into the computer a vibrating member which kept the whole mechanism in constant state of minor but rapid vibration, that it would dampen out the trouble, which it did. They easily compensated for the internal vibration since they knew exactly how much had been built into the system.

STIMULATION: Now a quarter of a century later, and speaking of an important aspect of the team approach to research, I would like to quote from a fairly recent issue of SCIENCE--"We need a certain amount of dither in our mental mechanisms. We need to have our ideas jostled about a bit so that we do not become intellectually sluggish."

COOPERATION: Another point to consider has to do with one's point of view. This can best be illustrated by a statement made a few years ago by our former Provost of Agriculture, Mr. W. M. Fifield, who in his 30 years service started out as an Assistant Horticulturist and moved all the way to the top agriculture position. He stated "As a new assistant horticulturist at one of our branch stations, I was well aware of my responsibilities and my prerogatives. I was willing to cooperate, but I didn't want anyone else telling me how to conduct my research. One day I found myself in charge of the station. Immediately I expected my staff to work together as a team, but I didn't want other stations and departments horning in on our territory or research areas. I even resented fool instructions sent down from the Director's office. Then I became Director. I encouraged projects which crossed department lines, but I didn't want people in Extension or Resident Instruction telling me how I should run the Experiment Station. Some of the ideas of the Provost for Agriculture were at variance with my ideas. Then one day I became Provost. All three agricultural divisions of the University were most vital, and should work together harmoniously! Extension specialists should be housed in the subject-matter departments. But I find that agriculture's importance in the scheme of things isn't fully appreciated in other areas of the University.

The point I am making here is not that there are differences in degree of cooperation depending upon position, but rather that cooperation and team efforts are essential at all levels, particularly at the research level.

ISOLATION: Now for a moment let us give thought to just exactly what are we trying to accomplish. Isn't research and discovery our primary mission? And underlying that is the most important ingredient, the idea. Well, we all know that such ideas, whether great or small, must come from one mind only. If we look back at the few hundred great fundamental discoveries of the past we

*Presented by Dr. O. C. Ruelke.

find most of these great scientists were essentially solitary workers. Even in recent years it is most often the case that solitary workers are the Noble prize winners. But it must be remembered that these people represent but a few of the many thousands of scientists and millions of contributions now pouring forth today. Along this line, here is what the great American Novelist Henry James had to say--"The best things come, as a general thing, from the talents that are members of a group; every man works better when he has companions working in the same line, and yielding to the stimulus of suggestion, comparison, emulation. Great things of course have been done by solitary workers; but they have usually been done with double the pains they would have cost if they had been produced in more genial circumstances. The solitary worker loses the profit of example and discussion."

RESEARCH PERFORMANCE: Now let's turn our attention to some research conducted at the Institute of Social Research, University of Michigan, at Ann Arbor. Just as we have been studying plants, they have been conducting some very fine research on another biological species--people. More specifically they have studied large numbers of scientists to obtain a better understanding of factors influencing research performance or productivity. They designed their studies well, in my opinion, and used various measurement criteria, such as self evaluation, evaluation by colleagues, measurements of publications, reports and talks, and other ways including dither-factor measurements. From a number of published papers on various related aspects of these studies, I have briefly summarized some of their findings which are particularly applicable to agricultural research personnel like yourself. In these studies the Institute found the following:

Research scientists perform somewhat better--both in terms of research contribution and in terms of evaluations by other staff members--when they have frequent communication with their significant colleagues. High producers of research resulted when two factors were jointly present, (1) the scientist communicated frequently with colleagues, and (2) particularly when such colleagues were from disciplines other than his own. It was found that dissimilarity from one's colleagues may be a source of desired "dither" which stimulates a fresh approach to problems, with high performers tending to be dissimilar from their colleagues.

The scientist's non-supervisory colleagues can provide another source of stimulation. Daily contact with colleagues of widely differing values and experiences is one condition for high performance, although people also do well who have only limited contacts with like-minded associates. In a group of varied viewpoints, one or two like-minded colleagues may be needed to lend courage to the individual's bizarre ideas.

CREATIVITY: In testing certain aspects of creativity, those with greater capacity showed a preference for research on specific rather than broad problems. Such creativity was a handicap however, in a restrictive setting where the individual had little influence on over-all program, had low professional status or there existed poor communication channels.

Funds alone do not guarantee achievement, and large research organizations, through curtailing freedom, run a danger of inhibiting creativity.

In measurements of self-image, it was found that when scientists rated themselves rather high in "creativity" it was positively related to total

research output.

Performance is better for those scientists who not only communicate but at the same time don't feel a need for competent colleagues--that is, who maintain an independent frame of mind.

LENGTH OF SERVICE: Concerning length of service, research performance was clearly curvilinear with the peak typically occurring at 16-20 years past the degree. The peak occurred earlier, and dropped more sharply, in labs emphasizing research than in those stressing development.

Some findings suggest that an atmosphere of intellectual "dither" may be more helpful in the advances of scientific knowledge than in the useful application of knowledge in development, where experience and cumulative wisdom is valuable.

Groups which had been together longer tended to perform less well. It may be that periodic regrouping of personnel is one way to provide fresh ideas.

MOTIVATION: Concerning motivation, performance was somewhat better when scientists had frequent communication with significant colleagues and with their chief, but also when they had at least moderate self-determination--either some autonomy from the chief in deciding their technical goals, or some influence on whoever does decide.

Isolation is not necessarily the optimal atmosphere for achievement. Best performance is observed when the scientist has high self-determination combined with free access to someone in authority.

UNCERTAINTY: In studies on uncertainty and anxieties, the scientist's research performance was higher when there existed within the environment factors which brought about an intellectual jostling. Such dither will be more effective when the individual feels secure with respect to his environment than when he feels anxious. When the scientist is secure, he can benefit more from uncertainty than when he is insecure.

SECRECY: Concerning competition and secrecy, they found that when such conditions were allowed to exist which permitted the presence of secrecy and competition that it tended to inhibit the research output when present within the immediate group or team. These affects were not found in relations between different separate groups or between organizations.

LEADERSHIP: Scientists perform better when they see their administrative chief rather often. In a study of leadership, leadership style of laboratory directors were identified as directive, laissez-faire, or participative (characterized by a high degree of interaction with subordinates and joint decision-making practices). Under the latter scientists tended to place higher importance on research values, to feel a greater sense of progress toward research goals, and to have more favorable attitudes toward the laboratory chief.

In a study of the scientist and his administrative chief, it was found that when chiefs were selective in their leadership behavior (i.e. when they performed useful functions more frequently than less useful) their subordinates performance tended to be higher. For best research performance one must be less concerned with what the administration is doing, accepting general policies willingly by exhibiting a mild attitude toward the institution and a strong attitude toward science.

TIME AND EFFORT: In another study considering time and effort, it was found that scientists performed better when they devoted two-thirds of their time to technical work such as research--but not full time. Better performance also occurred when influence on important decisions was shared between the scientist and a number of other persons in his environment.

Finally, the optimal level of self-determination also depends on the individual's strength of motivation or involvement toward his work. If motivation is low, only moderate self-determination is advisable. If motivation is high, then full self-determination leads to best results.

ORGANIZATION: A final point I would like to mention dealing with the team approach to research has to do with organization. We have in the Florida Agricultural Experiment Station which is fourth largest in the country, an extensive branch station system which comprises about 50 percent of the total staff and facilities. The major branch stations are staffed with research personnel trained in many varied disciplines or commodities. This interdisciplinary type of organization has been most effective in terms of research performance. At the Main Station, here on the campus, we are organized in the usual manner found in Land Grant Agricultural Universities of various discipline and commodity departments having only a limited number of interdisciplinary staff appointments.

We are presently giving careful re-examination of our organization with the hope of improvement of the over-all Station research program. Since this is only in the planning stage, no details or mechanics are available at this time. The principle objectives, however can be stated, which are to strengthen and improve the opportunities for basic research and provide for greater team effort in applied research. In order to strengthen the truly basic research program, discipline departments would have fundamental research as their primary objective. This should both increase and strengthen the basic research studies which are needed and should be expanded. The commodity departments would have a broader responsibility than commonly recognized, and would be responsible for all applied research from producer to consumer. Both the discipline-oriented departments and commodity-oriented departments would be more closely coordinated in their broad research programs as well as individual research projects by a system of dual appointments of research staff. In turn this should lead to greater team effort as well as better cooperative projects. With the agricultural research program organized in such manner as to take into consideration these primary objectives, it should make it possible for the individual research worker to improve his opportunity for cooperation, for quality research and the administration for coordination, planning and direction.

CONCLUSION: On the basis of the points mentioned of the future role of team effort in research, we may conclude that it is not only here to stay but should be encouraged wherever possible. Not only are team efforts enjoying a high level of financial support, but also have proven to be both desirable and necessary in this age of tremendous scientific investigation and progress. It seems highly desirable for a research worker to occasionally stand back and take a hard look at himself in relationship to his colleagues and his own research effort. As many studies and observations have shown, the individual research

worker will most likely gain more than he loses by becoming a member of a team on a specific cooperative project.

A Challenge to the Pasture Scientists - F. H. Hull, Head, Department of Agronomy, University of Florida.

A recent estimate is that agricultural production in the U.S.A. costs 13 billion less than it would by 1940 methods and equipment. The housewife benefits about 5 dollars on the weekly grocery bill. I feel sure that forage research has contributed its fair share or more to this gain in efficiency.

How much additional gain may be expected in the next decade? Is forage research adequately financed to provide advances which the commonwealth should fairly expect? Are we presently training our future forage research workers adequately, or where are the greatest deficiencies? It would seem that the best answers to these difficult questions might be expected from a forage research conference.

Much is being said currently about the need for more emphasis on original research to provide a greater fund of basic information for which applications may be found. Research on agricultural problems is often necessarily empirical providing extensive tables of data. From such data it is usually difficult and often seemingly impossible to derive general principles or universal laws of science. The same is true of other applied fields.

Writers who propose more basic research, not infrequently mention creative research. I think they often say "basic research" when actually meaning "creative research" or in less formal terms "ceiling busting". Back up and take a fresh start in a new direction.

The American Association for the Advancement of Science held a Symposium of Basic Research in 1959. The National Association for Research in Science Teaching held a Symposium on Creativity in Science in 1961.

Everyone knows what creativity is, and most everyone favors more creativity in all phases of science research. No one it seems has been able to state specifically how creative research may be done.

School grades and I.Q. scores are inadequate measures of creative ability. Some persons of very high I.Q. are not at all creative. The thinking processes of acquiring basic knowledge and of producing new ideas or devising new research procedures are not the same.

One who sets out purposefully to do creative research must be willing to endure the pain of intellectual persistence--to THINK, and THINK, and THINK. He must also become steeped in all of the factual data which bear on the problem. Someday when the problem is out of mind and the researcher is engaged in some trivial task or doing nothing at all, the brilliant mental flash may strike. Then he may say, "Why did not someone think of that before?" Such is the reported experience of those who have done creative work.

It would seem that every research conference such as this one might well have a Think Committee charged with developing new ideas or new methods of attack on difficult problems.

Challenges to the Pasture Scientists From the Animal Scientists - T. J. Cunha,
Head, Animal Science Department, University of Florida.

Some of the challenges listed herein are not only for the pasture scientists but, in some cases, will likewise apply to the animal scientist as well. Following are ten items which the pasture scientist might consider as challenges for the future:

1. Develop more cooperative research programs between the pasture and animal scientist.
2. Develop a nutritious year-round grazing program for livestock which is practical and economical.
3. Determine the factors which control how much forage an animal will consume and develop a simple laboratory method to predict their consumption.
4. Develop programs which will tell from a rapid analysis of a representative sample of a rancher's pasture how much supplemental feeding is required.
5. Develop better and more meaningful criteria of quality in forages.
6. Determine the effect of high levels of fertilization on animal response and especially on a cow and calf basis.
7. Improve animal weighing techniques in forage evaluation studies.
8. Improve fertilization techniques or fertilizers in order to produce maximum pasture quality for a longer period of the year.
9. Develop better methods of harvesting and preserving forages.
10. Develop forages with a wide range of adaptability to environmental conditions.

While we need to develop new species and varieties of grasses and legumes, we should likewise place considerable emphasis on improving the productivity of those we already have. Rising land values and increased taxation rates are making it mandatory for beef cattlemen to produce more and better quality beef per acre. This means the pasture and animal scientists need to keep pace and develop more productive and higher quality forage for their use. The beef cattle industry in the southeastern States will expand at a faster rate in the future than other sections of the United States. Thus, all of us in pasture and animal science disciplines have a challenge to make possible the full potential which the Southeast has for increased beef cattle production. This cannot be done, however, without good economical pasture programs.

Business Session - Chairman Ruelke, Presiding.

Chairman Ruelke appointed the following committees to report at the final business session: Nominations, Chairman, R. M. Patterson, H. W. Bennett, and G. B. Killinger; Resolutions, Chairman, T. H. Taylor, C. R. Owen, and W. E. Knight. Chairman Ruelke indicated that obviously that it is impossible to see everything on a single tour of research centers but stressed that the tour planned for the afternoon will acquaint the group with where and by whom some of the work is being done and indicated that those having interest in specialized research can arrange for appointments for individuals or

groups after the tour. He announced that the tours would assemble at 1 p.m. in parking lot #7, adjoining Dan McCarty Hall.

Wednesday - April 22 - Afternoon

Tour of Research Centers

Animal Nutrition Laboratory - R. L. Shirley.
 Beef Cattle and Sheep - J. F. Hentges & P. F. Loggins
 Animal Nutrition - J. E. Moore, C. B. Ammerman & J. F. Hentges
 Animal Environment - A. C. Warnick
 Nuclear Science Research in Plants & Animals - G. K. Davis
 Agronomy Research Farm - F. H. Hull
 ARS Entomology Laboratory - C. N. Smith
 Computer Center - Ramon Bradley
 Crop Weather Research - G. M. Prine & K. D. Butson
 Physiology, Ecology & Microclimatology - G. M. Prine & O. C. Ruelke
 Alfalfa, Clover & Corn Breeding - E. S. Horner
 Weed Control - E. G. Rodgers & M. Wilcox
 Genetics & Small Grain Breeding - P. L. Pfahler
 Genetics & Lupine Breeding - J. R. Edwardson
 Genetics & Soybean Breeding - Kuell Hinson
 Crop Management & Peanut Breeding - A. J. Norden
 Mineral Nutrition - H. C. Harris
 Cobalt 60 Irradiation - A. T. Wallace
 Genetics & Digitaria - S. C. Schank
 Tobacco - Fred Clark
 Dairy Research - E. L. Fouts
 Pasture and Forage Crop - S. P. Marshall
 Cattle & Calf Feeding & Management - J. M. Wing
 Genetics, Breeding & Production - C. J. Wilcox
 Physiology of Dairy Cattle - H. H. Head
 Dairy Cattle Nutrition & Performance - R. B. Becker
 Beef Research - T. J. Cunha
 Beef Cattle Improvement by Breeding - Marvin Koger
 Pasture Soil Fertility - W. G. Blue
 Forage Screening & Management - G. B. Killinger
 Economic Research in Beef Cattle Management - R. E. L. Greene
 Engineering Research in Water Control - J. M. Myers

Thursday - April 23

ALL INTEREST GROUPS

R. E. Blaser, Virginia, Presiding

Forage Quality Symposium:

What do animals tell us about forage quality? - C. B. Browning

There is a great deal of talk and discussion regarding the importance of high quality forage in feeding cattle--but what is a high quality forage? Some workers have defined a high quality forage as "one with a high nutritive value" and then have defined nutritive value as the chemical composition of the forage times its digestibility. This is a concise definition and defines nutritive value, but nutritive value does not completely define forage quality. A relatively simple definition is that a high quality forage is one, first, with the greatest possible concentration of utilizable nutrients, and second, with these nutrients put in a forage "package" that is highly acceptable to the animal.

When we speak of acceptability we are usually referring to a measure of the rate of intake of the forage expressed in terms of weight of dry matter consumed per unit of animal weight or metabolic size. How does this differ from "palatability?" Most if not all definitions of palatability infer the readiness of forage selection by an animal or group of animals, i.e., the animal has a choice of several forages and prefers one to others. Whereas when measuring rate of intake, (voluntary consumption) or acceptability as above defined, the animal does not have a choice at the time of measurement. Palatability as most of us think of it no doubt influences acceptability but how important is a measurement of forage selection alone as an indication of forage quality? A forage that is not "selected" may be consumed at a high rate and be of high nutritive value when offered to an animal that has no choice.

The quality of a forage is actually a measure of its ability to promote within the animal's body various physiological responses such as growth, milk production, and others. Forage quality is therefore basically a biological measurement. The ultimate measure of quality is the performance or response of the animals consuming the forages.

However, animal performance trials are expensive, time consuming, often difficult to control, and the results are not always readily interpretable. There are further limitations: low producing animals may limit the amount of information gained, and a limited number of animals may give erroneous results. Therefore, there have been numerous attempts to develop simple, accurate inexpensive, reproducible measures of forage quality.

Human "know-how" and "common sense" are no doubt responsible for the "eyeball" test of forage quality. Most people know that when a forage is cut at the "proper" stage of maturity, has a good texture, is leafy, has good color and smells good, it is high in quality; however, the cow does not always know this and consequently physical characteristics such as those listed are not

consistently well correlated with animal response.

Nutritionists as well as agronomists have long been disillusioned by the value of the chemical composition (proximate analysis) in the evaluation of forages. Chemical determinations such as those for crude protein, crude fiber, or lignin without doubt help to characterize a forage but these measures, just as indicated for physical characteristics, do not consistently correlate with animal performance. There are several groups of workers putting forth a great deal of effort at the present time in an attempt to develop superior chemical techniques or schemes to accurately evaluate forages. Several of these, such as the acid detergent lignin procedure and cellulose or dry matter solubility technique, just to mention two, show promise. Only time and additional research will indicate whether these and other chemical techniques will predict or measure forage quality as animals see it.

As has been said, we must still go to the animal for the ultimate measure, so what does the animal tell us? The animal, through the results of properly designed and conducted trials, can tell us:

1. How acceptable a forage is (vol. consumption), and
2. How digestible the nutrients of the forage are.

These techniques of measurement (acceptability and digestibility) have been used to "short cut" the more involved animal performance trials. While it is appreciated that rate of intake and digestibility many times explain animal performance and are, without doubt, associated with performance, neither one alone consistently describes the feeding value of forages as measured by the performance of animals.

As an example of this, it is not uncommon to find when two forages are compared that the one with the lower digestibility elicits the greater performance when fed to lactating cows. Even more frequently there is little or no difference in digestibility among several forages that are grossly different as measured by performance of animals.

It is generally agreed that digestion data fail to consistently correlate with animal performance because feed intake is not considered in conventionally determined digestibility. There is further agreement that forage value and therefore animal performance is governed by both the voluntary intake of the forage and the extent of the digestibility of the energy of the forage.

Crampton et al. (1960) proposed that the Relative Intake of a forage times the per cent Digestibility of its energy be used as an index of nutritive value. This work resulted in the now familiar N.V.I. Several workers in recent years have stressed the importance of rate of digestion as opposed to ultimate digestion as determined in a conventional digestion trial. Rate of digestion is presumed to be associated with rate of passage of rumen ingesta and rate of passage with rate of intake. Thus, the importance of considering forage intake in quality determinations is readily apparent since DE intake is limited by forage intake.

This need that we have spoken of for a simple means of predicting forage quality that consistently correlates with animal performance has stimulated a

great deal of research with in vitro rumen fermentation techniques during the past five to seven years.

The ability of several relatively simple in vitro techniques to predict in vivo cellulose digestibility has been well demonstrated. More recently several groups of workers have demonstrated the ability of certain in vitro rumen fermentation techniques to predict rate of intake of forages. The accuracy of this relationship between early rumen fermentations in vitro and rate of intake must be proven on a great variety of forages before it can be fully accepted. However, these in vitro procedures (that might be classified as "indirect or simulated animal studies" since their basis is fermentation by rumen micro-organisms) show a great deal of promise as laboratory tools for the prediction of forage quality.

In vitro rumen fermentation techniques as well as the small sample in vivo technique offer the agronomist and particularly the plant breeder an opportunity to arrive at an estimate of forage quality to augment his measures of yield, protein content, fiber, etc.

We have used the small sample in vivo technique in research designed to measure the change in digestibility of the plant with increasing maturity. This technique is the only one now available to measure rate of digestion in the intact animal and to effectively measure associative effects of digestion.

As was indicated earlier, forage evaluation is basically a biological measurement since we are attempting to determine how the over-all nutrient content of the forage will be utilized to promote various metabolic functions in the animal. Therefore, as suggested by various workers we must, through research, become aware of the reactions which take place within the rumen and the importance of the absorption and metabolism of the ruminal end-products. Animals might tell us more about forage quality in the future than they have in the past if we learn more about such rumen metabolites as the VFA's and the importance of these metabolites in (1) energy utilization, (2) fat synthesis, and (3) their influence on forage intake and appetite.

How has the quality of forage varieties been improved and what is the future outlook? - A. A. Hanson

There is a widespread impression that forage crop breeders and geneticists have paid little attention to quality. If breeders have appeared to ignore quality it is because (a) there were more immediate and more important goals; (b) quality has been so poorly defined until recently that breeders have experienced difficulty in establishing effective selection criteria; and (c) the relatively poor acceptance of improvements in quality (leafiness, increased resistance to foliar diseases, etc.) when this improvement has been realized with no gain and perhaps some loss in total yield.

Indirect contributions to forage quality often accrue when the major breeding objective is improved persistence or a better seasonal distribution of forage yield. Improved persistence in alfalfa (attributable to gains in winter-hardiness, spotted alfalfa aphid resistance, wilt resistance, etc.) avoids the

necessity of finding alternative hay crops, many of which would be lower in quality than alfalfa. A somewhat similar situation prevails in those species where it has been possible to select for a different seasonal growth pattern. Extending the grazing season and improving production at periods of the year when alternative forage sources are of low quality can make a real and significant contribution to the improvement of forage quality. The elimination of toxic substances has encouraged the use of good quality annuals and perennials that might otherwise be avoided because of the possibility of poisoning and the loss of animals.

Direct contributions to quality include selection for improved palatability, leafiness, and resistance to foliar diseases. Progress has been made in reducing coumarin content in sweetclover and the bitter characteristic in lupines. Appreciable gains have also been made in selecting for resistance to leaf diseases that reduce both quality and acceptability.

In the immediate future, breeding for forage quality will involve increased emphasis on resistance to foliar diseases, the transfer of desirable characteristics through interspecific and intergeneric hybridization, and studies on the possibility and potential value of selection for specific chemical constituents. Major emphasis, however, must be devoted to genetics and the development of superior breeding methods, for herein lies the key to truly effective gains in forage quality.

What are the prospects of improving forage quality through management? -
W. C. Templeton, Jr.

Management affords opportunity for improving forage quality through choice of available species and varieties of plants, certain cultural practices, and choice of livestock programs. In addition, judicious scheduling of harvests and the conduct of processing and storage operations according to proven techniques will insure maintenance of forage quality at levels near optimum for the species or mixture.

As yield and quality of a given crop may be, at least at certain levels, negatively correlated the operator should generally strive to improve quality only to the extent that it ceases to be a limiting factor in his system. At that point consideration logically might be given to the feasibility of changing livestock programs to more effectively utilize a superior forage product.

Efficient production of livestock products from grasslands is a very complex operation with many interacting factors involved. For that reason skillful management pays excellent dividends. It would appear that the welfare of poor managers will become more hazardous as improved knowledge concerning grasslands and their utilization is made available.

BREEDING AND GENETICS

Ian Forbes, Jr., Georgia, Presiding

Current status of pangolagrass in Florida, and objectives and progress in Digitaria improvement - S. C. Schank and E. M. Hodges

Pangolagrass, *Digitaria decumbens* Stent., occupies about 500,000 acres or

1/4 of the total improved pasture acreage in Florida. It was selected by Ritchey from approximately 50 South African introductions of Digitaria during the 1914-1949 period because of its abundant foliage, rapid spread, sod forming habit, resistance to drought, and nutritive value (Conway & Ritchey 1950). It is not widely distributed in the United States, because of its lack of winter-hardiness, but has found climatic conditions of penninsular Florida favorable for continued success.

Several years data by Hodges et. al. (1955) have shown that under grazing, pangola consistently produced the highest animal weight gain per acre of 8 grasses tested.

Pangolagrass has also been preserved as both silage and hay over the past decade and it is still considered the most productive grass in Central Florida (Kirk, et. al. 1960). Limitations are its susceptibility to winter kill and spittle bug infestations.

Objectives in Digitaria improvement are: (1) To maintain a collection of Digitaria species to be used as parental stocks for cytological and breeding purposes. (2) To obtain cytogenetic information in order to aid an interspecific breeding project which will increase our basic knowledge about speciation in this genus. (3) To explore new and old breeding techniques and to make interspecific hybrids. (4) To investigate induction of polyploidy in pangolagrass and in species hybrids.

The species D. decumbens, pangolagrass, is sterile, most likely because it is an interspecific hybrid between two unknown Digitaria species. To circumvent the problem of sterility in pangolagrass, the breeding program at Florida uses related species of Digitaria, primarily from African and South African sources. From 1959 to 1963, some 225 Digitaria accessions have been grown at Gainesville, Florida. Inability to perenniate has reduced the number of survivors to about 63 introductions in 1964.

Cytogenetic information, and preliminary information on selfing and breeding behavior is being collected from these introductions and a portion of the data has been previously reported (Schank 1963) (Schank and Tan 1964).

Hybridization work on the Digitarias has made use of the mutual pollination technique (Hanson and Carnahan 1956). Two panicles were tied together and placed in isolation. The panicles mature about 30 days after flowering, and were taken directly to the laboratory, where they were passed over a light box to screen for full caryopses. The fully developed caryopses were placed on filter paper in petri dishes in a Mangelsdorf germinator and non germinated. By peeling the lemma and palea away with tweezers and a needle, the germination was improved greatly. Each seedling plant was transferred to a pot when the radicle was about 10 mm. long. Several months later each plant was clonally divided for transplanting to the field.

Other crossing procedures and emasculation techniques are under experimentation with the Digitaria species. Sixteen crossing cubicles have been

constructed patterned after the cubicles used in sugar cane breeding work (Dunckelman 1963). A water mist spray which prevents anthers from dehiscing, hot water emasculation and mechanical emasculation are currently under test.

In addition to the interspecific breeding program, attempts are being made to double the chromosome number of D. decumbens with colchicine. Latest techniques include using a 0.2% aqueous colchicine solution in 10% sucrose and 50 ppm boric acid. Doubled pangolagrass could possibly be important by (1) being fertile; (2) being more winter hardy, or (3) being more palatable.

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The status of plant parasitic nematode injury to pasture and forage crops - J. M. Good

Knowledge of damage caused by plant parasitic nematodes to pasture and forage crops is fragmentary. To date most of our knowledge is limited to the damage caused by root-knot nematodes. Little is known about the importance of many other genera of destructive parasitic nematodes. There is increasing evidence that many types of ectoparasitic and endoparasitic nematodes attack forage legumes and grasses causing reduced growth, poor stands, increased disease susceptibility, poor root development, and increased need of fertilizer and water.

Most of the commonly grown legumes including clovers, lupines, vetch, lespedeza, winter peas, cowpeas, and alfalfa are highly susceptible to one or more types of nematodes. Growing these crops in rotation with other cultivated crops can be disastrous in many areas of the country. It would be highly desirable that new varieties of these crops have a high degree of resistance to one or more types of nematodes. Chemical control of nematodes on these crops is not practical, and use of nematode susceptible cover crops and sods will

necessitate an ever increasing need for soil fumigation on cultivated crops that follow these crops.

Forage grasses are generally thought not to be as susceptible to nematodes or to increase nematode problems to the same extent as most cultivated crops. However, recent investigations have indicated that many grasses including Coastal Bermuda increase numbers of many types of destructive parasitic nematodes, including sting, lance, stubby-root, and cyst nematodes. Grasses such as corn, millet, sorghum, sugar cane, milo, and sudangrass are all excellent hosts for many types of nematodes.

Additional research is badly needed on sod and forage legume rotation studies, breeding for resistance, and basic pathological studies on 8 and 10 important groups of parasitic nematodes attacking grasses and legumes that are used for pasture and forage.

The current status of pearl millet breeding - Glenn W. Burton

Pearl millet, *Pennisetum typhoides* S. & H., is a robust, annual bunch grass that reaches a height of 3 to 5 feet when mature. Its cattail like spikes range from 4 to 50 inches in length. Mature plants have from 1 to 20 culms. It reproduces sexually and has unusually large chromosomes ($2n = 14$). It has a protogynous flowering habit, is highly cross-pollinated, and is an extremely variable species. Pearl millet is drought resistant, is unusually well adapted to poor soils, is capable of yields in excess of 8 tons of dry matter per acre when well fertilized and clipped at 4-week intervals, and contains none of the prussic acid glucosides that is a problem in the sorghums.

In Africa and India, the grain is used for human food and the dry fodder has considerable importance. In the United States, the crop is used primarily for pasture and silage production.

Some of the people concerned with breeding pearl millet in the United States are: R. R. Kalton, Ames, Iowa; E. F. McClain, Clemson, South Carolina; C. O. Grogan, State College, Mississippi; G. W. Burton, J. B. Powell, and H. D. Wells, Tifton, Georgia.

Major breeding objectives around the world are improved grain yield and quality, increased forage yields and quality, better seasonal distribution of forage, disease resistance, bird resistance, and the ability to germinate at low temperatures.

Pearl millet breeding research shows that: (1) Inbreeding depression always occurs, (2) heterosis is significant, (3) 100% hybrid seed is not necessary, (4) 50% of total genetic variance is non-additive, (5) epistasis exists, (6) F_1 's will give maximum yields, (7) syn 1 outyields syn 2 and syn 3, (8) CMS 23 F_1 hybrids have high green ear resistance, (9) cytoplasmic male sterility (A, B, and R) is heritable, and (10) late (78) types are better than early (53) types for forage.

Some marks of progress in pearl millet breeding on a world-wide basis are:

the world-wide germ plasm collection directed by Dr. K. O. Rachle of the Rockefeller Foundation, the exchange of breeding stocks, the exchange of ideas, and the pooling of supply orders.

Cytogenetics in pearl millet improvement - Jerrell B. Powell

Pearl millet, from a cytological standpoint, has not been extensively investigated. Most of the reports are from India, although some of the early work, particularly that on interspecific hybrids, was carried out at Tifton. The presence of seven large chromosome pairs is well established. One pair has a satellite and organizes a nucleolus. Meiosis and the chromosomes in general terms have been described. One report has been published of a natural occurring translocation in the variety, Starr, and another report describes an accessory chromosome.

Two immediate objectives in our program are to (1) characterize the chromosomes as regards structural rearrangements, unusual behavior, and extent to which "B" chromosomes are present, and (2) associate specific chromosomes with specific genetic traits.

The observations presented were concerned with the first objective. An inbred line has been found with large accessory chromosomes. Plants within the line had two, three, and four accessories. Unlike most accessory chromosomes, they associated with the nucleolar chromosome. A second chromosome of the "A" group was also found to associate with the primary nucleolus. Cytoplasmic male-sterile inbred 23, which has sterile pollen (forms no starch), was found to result from a breakdown after Anaphase II and before first pollen division. Based upon preliminary studies, karyotype analysis in pearl millet may be technically easier using metaphase of first pollen division rather than root tip metaphase cells.

Current status of sudan and forage sorghum breeding - J. P. Craigmiles, J. P. Newton, and D. G. Cummins

Grass- and forage-type sorghum hybrids have increased in popularity in the last few years. Most of these hybrids are more productive, produce more forage later in the season, and have a higher drought tolerance than most species tested, even though they do carry a potential for hydrocyanic poisoning.

The development of a cytoplasmic male sterile sudangrass and the subsequent release of Suhi-1 sudangrass in 1961, stimulated considerable grower interest. Seed production of Suhi-1 has not been economically attractive because the extreme height of the male sterile does not lend itself to mechanical harvest. To correct this, triple dwarf genes from CK 60 grain sorghum have been incorporated in the B line by 4 cycles of alternate generations of backcrossing, selfing, and selection. Simultaneous selection for sweetness, juiciness, low prussic acid, and a nonshattering seed characteristic was also conducted. The height of Rhodesian sudangrass has been reduced from 12 feet to 4 feet in the B line and the dwarf factors are being transferred to the A line. After two backcrosses, the A line should possess enough homozygosity for use in an F₁ hybrid for experimental testing. The pollinator, Tift, will restore full

height to the hybrid. Gamma radiation was used in an unsuccessful effort to obtain a desirable dwarf plant in two generations instead of the 8 required by breeding.

Forage sorghum hybrids are more drought tolerant and some are equal or superior to pearl millet in forage production. All sorghums have a potential for prussic acid poisoning; millets do not.

Problems in sampling sericea lespedeza for tannin determinations - R. E. Burns

There are two means of obtaining new or improved forage plants for the Southeast. One is to take plants of proven forage quality and attempt to adapt them to this area. The other method is to take potential forage species that are adapted to this area and improving their quality. A good example of the latter is sericea lespedeza with two improved varieties recently released. However, one factor still limiting its usefulness is a relatively high tannin content.

Evaluating sericea varieties for tannin is hampered by the difficulty of getting standard tannin results. The reason for these difficulties is due to the many factors affecting tannin content in the plant, and their interrelationship.

The effects of season on tannin content depends on weather, management, and maturity of plants. The response to transfer to cool temperatures is a rapid change in tannin content followed by a return to the original concentration. Thus, the results differ depending on time after transfer that the sample is taken. Another factor involved is possible differences in tannin content of stems from the same plant, apparently in response to microclimate. Difference in tannin content may be due to location of a plant in a flat or a pot in the greenhouse. The amount of water retaining volume in a pot will effect tannin content due to differential leaching and moisture regime. There is also a difference in tannin content of leaves depending on location on the stem.

With a knowledge of these variable and the appreciation of necessity for uniform conditions, the assessment of sericea for tannin content is made more valid.

Paper chromatography for compatibility investigations in Trifolium - N. L. Taylor and G. B. Collins

Root samples of Trifolium species were analyzed by use of paper chromatography of the one-dimensional descending type in a 4:5:1 (n-butanol:distilled water:glacial acetic acid) solvent system. The resultant patterns were closely related to compatibility as indicated by successful interspecific crosses, and to taxonomic position. Patterns of two species which were hybridized recently at this station, T. pratense L. and T. difusum Ehrh. were identical. The technique appears to have considerable value for predicting hybridizations within the genus.

The improvement of white lupine (*Lupinus albus*) for winterhardiness - M. S. Offutt

The sandy Coastal Plain soils in southern Arkansas are low in organic matter and are subject to serious erosion and leaching from high winter precipitation unless they are protected by a cover crop. On these soils, the common variety of white lupine (*Lupinus albus*) has consistently produced higher yields of dry herbage and seed than any of the other winter annual legumes tested, except in those years when winter temperatures were well below the long-time average.

Early spring planting of field and horticultural crops on the Coastal Plain soils is necessary in order to avoid as much of the adverse effects of the hot, dry summer weather as possible. It is advantageous, therefore, to utilize winter cover and green manure crops that make early, rapid spring growth for turning under prior to the planting of field and horticultural crops. In this respect, experimental results have shown that the dry herbage yields obtained from common white lupine in late February were equal to those obtained from either hairy vetch or Austrian winter peas in late March in southern Arkansas.

Common white lupine, although having a high potential for forage and seed production in Arkansas, has a relatively low level of winterhardiness. Because of its potential usefulness, a program to improve the winterhardiness of common white lupine was initiated at the Arkansas Agricultural Experiment Station in the fall of 1958. The recurrent phenotypic selection method has been followed in this program.

Under Arkansas conditions, common white lupine usually has been injured rather severely by temperatures of 15°F. and lower. The mean temperatures for the 5 winter months, November through March, averaged from 4 to 6°F. lower at Fayetteville than they did at Hope for the 5-year period, 1958 to 1962, in which the program to improve the winterhardiness of common white lupine was carried on. During the same 5-year period, the average number of days per year with a temperature of 15°F. or lower was 18 at Fayetteville as compared with 6 at Hope. The lowest yearly minimum winter temperature for the 6-year period, 1958 to 1963, averaged -4°F. at Fayetteville as compared with 7°F. at Hope, or an average difference of 11°F. between the two locations.

In the Arkansas program, the level of winterhardiness in white lupine lines has been increased markedly over that of the Common white variety with six cycles of recurrent phenotypic selection. Nine lines have been developed that have withstood temperatures as low as -10°F. without snow cover with less than 25% winterkill. A summary of the history and procedures used in the development of the winterhardy white lupine lines by the Arkansas Agricultural Experiment Station is presented in Table 1.

On the basis of results obtained to date, it would appear that Arkansas is in a favorable geographical location for improving the winterhardiness of white lupine under natural conditions in the field. By alternating selection cycles between the northern and southern parts of the state, it has been possible to screen large populations for winterhardiness at Fayetteville and to increase seed and check the performance of winterhardy lines in southern Arkansas, the area for which they were developed.

Table 1. History and Procedures Used in the Development of Winterhardy White Lupine Lines in Arkansas

Year	Location	Selection cycle	Procedures
1958-59	Fayetteville	1	(1) 4000 plants of Common white lupine variety established in fall. (2) 4 plants survived winter (lowest temp. -3°F.)
1959-60	Fayetteville	2	(1) 4 individual plant lines survived winter with less than 50% winterkill (lowest temp. 2°F.) Common white lupine 100% winterkilled. (2) Seed from each of 12 most vigorous plants surviving was harvested separately.
1960-61	Hope	3	(1) No winterkill (lowest temp. 14°F.) (2) Seed from most vigorous plants within each of 12 lines was bulked separately.
1961-62	Fayetteville	4	(1) 9 of the 12 lines survived winter with less than 25% winterkill (lowest temp. -10°F.) Common white lupine 100% winterkilled. (2) Seed from the most vigorous plants within each of the 9 most winterhardy lines was bulked separately.
1962-63	Hope	5	(1) All 9 lines survived winter with less than 5% winterkill (lowest temp. 3°F.) Common white lupine 100% winterkilled. 3 lines with good vigor. (2) Seed of all plants within each of 9 lines bulked separately.
1963-64	Fayetteville and Hope	6	(1) All 9 lines survived winter at Fayetteville with less than 25% winterkill (lowest temp. -10°F.) and at Hope with less than 10% winterkill (lowest temp. 6°F.) Common white lupine 100% winterkilled at Fayetteville and 50% winterkilled at Hope

The improvement of blue lupines (*Lupinus angustifolius* L.) for winterhardiness - Ian Forbes, H. D. Wells, and R. E. Burns

Winter injury is a major hazard to blue lupine forage and seed production in the coastal plain of the Southeast. In 1950, for example, bitter blue lupine cover and seed crops were a total loss in Georgia as a result of winter injury. At Tifton that year a 10°F. record low temperature on November 25 killed all of the blue lupine plantings. The winters have been generally colder since the 1940s, so winter injury to blue lupine has been more frequent, especially in the upper coastal plain. Since forage varieties (Borre and Blanco) did not become available until the colder winters of the 1950s, the use of blue lupine for forage in the upper coastal plain has been limited. Only in parts of north Florida, where winter injury is less likely, are these varieties coming into intensive use. An improved forage variety (experimental number 60-206), soon to be released, carrying resistance to anthracnose and grey leafspot should increase the use of blue lupine in the lower coastal plain. However, this variety will carry no increased winterhardiness.

After several years of testing numerous blue lupine accessions in field nurseries at several locations in Georgia likely to receive different minimum winter temperatures, it was found that a wild blue lupine native to Portugal (WH-1) was considerably more winterhardy than the commercial varieties. Hybrids were made between WH-1 and disease resistant elite forage lines, including 60-206.

In the winter of 1962-63 at Tifton a record 6°F. low in December and a 10°F. low in January provided nearly ideal conditions for screening for winterhardiness some 30,000 F₂ spaced plants of the WH-1 X 60-206 cross. The 6% of the F₂ plants that survived are being progeny-tested in 1963-64 for winterhardiness, resistance to anthracnose, resistance to grey leafspot, soft seededness, sweetness (very low alkaloid content), forage and seed production, maturity and variety marker genes. A severe, but useable progeny test of the F₂ lines for winterhardiness was obtained at Experiment, Georgia, where 4°F. and 5°F. occurred in December 1963, and January 1964, respectively. Thirteen F₂ lines appear to be homozygous for winterhardiness, resistance to grey leafspot and anthracnose, soft seededness, and sweetness. Some of these 13 lines are homozygous and some are heterozygous for one or more variety marking genes. These results indicate that a marked, winterhardy, disease resistant forage variety can soon become a reality. Such a variety should establish blue lupine as reliable forage crop throughout the coastal plain of Georgia and in other comparable areas in the Southeast.

Seed-shattering resistance in yellow lupines (*Lupinus luteus*) in relation to seed-borne bean yellow mosaic virus in Southeastern United States - Homer D. Well and Ian Forbes, Jr.

Sweet yellow lupine, *Lupinus luteus* L., was introduced from Europe into the Southern United States during the early 1940s. Its suitability as a temporary winter pasture resulted in the rapid establishment of large acreage of this crop. The early introductions became known as Florida Speckled sweet

yellow lupine. Their seeds shattered so severely that a 50% loss of the seed crop was common.

Immediately after the close of World War II, the Weiko II and Weiko III non-seed-shattering varieties were introduced from Germany into the Southeastern United States. These varieties hold all the seeds within the pods and remain on the plant until all of the plants in the field are dead and dry. This non-seed-shattering habit permits the harvesting of all of the seed produced at a sufficiently low moisture level to obviate redrying. Therefore, the Weiko II and Weiko III varieties became very popular and had almost completely replaced the Florida Speckled sweet yellow lupine by 1950.

During the period from 1948 to 1950, it is estimated that more than 200,000 acres were seeded annually to sweet yellow lupine in southern Georgia and northern Florida. By 1962 the acreage in this area had dropped to less than 1,000 acres. The drop in acreage resulted from the adverse effect of Bean Yellow Mosaic Virus (BYMV) on yellow lupine seed production. Virus infested plants flower but instead of setting seed normally, most of the pods abort. Diseased plants remain green for a considerable period of time after the healthy plants mature seed and die. Between 5 and 10 percent of the few seeds produced on virus infected plants carry the virus.

As long as the Florida Speckled seed-shattering-type of sweet yellow lupine were grown, the BYMV did not become a major problem in the Southeast. It is postulated that the seed-shattering habit forced the growers to harvest seed before seeds on the virus infested plants matured; thus, the virus infested seed were discarded in the process of combining. When Florida Speckled was used exclusively initial BYMV infection each year had to come from some other host plant growing in the vicinity of the yellow lupine planting. However, immediately after the non-shattering Weiko II and Weiko III varieties came into general use BYMV became of major importance. It is postulated that the non-shattering habit of the Weiko II and Weiko III varieties permitted the growers to delay seed harvest until the virus infested plants had matured seed. Therefore, during the combining process all the virus-infested seed were included among the seeds saved. Such virus-infested seed lots soon became common in the seed trade, thus a primary source of BYMV inoculum was distributed throughout the seedlings of Weiko II and Weiko III yellow lupine in Southeast United States. Within a period of 2 to 3 years after Weiko II and Weiko III came into use the virus was sufficiently widespread in seed lots to insure that from 80 to 100 percent of all plants would be infested each year by time of flowering. This high incidence of BYMV reduced seed yields by at least 80 percent and made seed production unprofitable. Since the use of sweet yellow lupine as a winter pasture depended on a cheap source of seed, the crop had to be abandoned.

Vetch and winter pea improvement in southern Oklahoma - R. P. Bates

Objectives of improvement work with these two legumes are to obtain the following:

1. Earlier forage production
2. Winterhardiness
3. Earlier maturity (harvest with rye seed)
4. Consistent seed production
5. Bruchid resistance
6. Pea aphid resistance
7. Varietal identification

In an effort to combine one or more of the above characteristics into a desirable variety, the following methods have been used:

1. Evaluation of plant introductions
2. Selection of vetches from local sources
3. Hybridization of vetches
4. Hybridization of winter peas

Progress in this breeding work, thus far, has produced several promising vetch strains as indicated by 1962-63 forage yields and winterhardiness notes in Table 1.

Table 1: Yield and Cold Damage of Vetch Varieties and Strains at
The Noble Foundation - 1962-63

Strain or Variety	<u>Dry Forage in Pounds per Acre</u>			Yield (% of common hairy vetch)	Cold Damage*
	April 1	April 29	Total		
Wolypod Selection					
1347	917	740	1,657	137	20
Common Selection					
1233	747	807	1,554	128	53
Wolypod Selection					
1210	790	680	1,470	121	20
Hairy Selection 1317	684	741	1,425	118	23
Austrian Winter Pea	746	589	1,335	111	23
Commercial Hairy Vetch	689	622	1,211	100	20
Wolypod Selection					
1353	566	497	1,063	88	63
Warrior Vetch	226	774	1,000	83	73
Lana Vetch	584	299	883	73	70
Narrowleaf Selection					
1354	36	438	474	39	53
Narrowleaf Selection					
1308	0	0	0	0	100

*100 = total killing, 0 = no damage, 20 = some browning, 70 = severe damage.

These strains, along with others, are being compared each year with present vetch and winter pea varieties. As seen in the table, hairy, wollypod, common, and narrowleaf strains are included in these comparisons.

Several attempts have been made to hybridize various vetch species. Most effort has been expended toward combining the winterhardiness of V. villosa with bruchid resistance of such species as V. atropurpurea, V. sativa, V. angustifolia, V. sericarpa, and V. cornigera. Thus far, none of these attempts have been successful. Attempts have also been made at crossing V. sativa and V. angustifolia. The objective of this cross is to combine the non-shattering seed pod of V. sativa with the reseeding ability of V. angustifolia. Narrowleaf vetch, V. angustifolia, appears to be a desirable reseeding vetch in Bermuda-grass, but seed shattering makes seed harvest very difficult. The only inter-specific hybrid definitely obtained is V. sativa X V. cornigera. Selections were made from this cross for three years and some very prolific plants were obtained. In January 1963, however, all these plants were killed due to low temperatures.

A plant introduction listed as V. sericarpa from Turkey looked very promising for two years, but was killed by low temperatures in January of 1963. The foliage and seed characteristics of this species appears to be between those of V. sativa and V. angustifolia. The seed do not shatter as does narrowleaf vetch seed. A few attempts were made at crossing V. sericarpa with V. sativa and with V. angustifolia. More attention should probably be given to the hybridization of these three species.

Several winter pea varieties from Finland were crossed with Austrian winter pea. A few crosses were also made among the Finland varieties. Hybrids were very easy to obtain and F₁ plants were obtained from most of the crosses. Each of the following hybrid generations was grown in space-planted nurseries for selection. Selections were made for early growth, winterhardiness, forage production, seed production and distinct seed characteristics. In January 1963, many of the F₄ plants were killed. Survival plants were from the crosses Kalle X Austrian winter pea and P.I. 203064 X Austrian. Plants from these two crosses appear to possess desirable characteristics.

While evaluating vetches, a need was seen for a more desirable type of nursery and test plots. In the past, vetches and winter peas have been evaluated and harvested for yield in wide rows. These legumes are nearly always grown in drill or broadcast stands. For the last five years we have been planting observation and clipping plots in 1-foot rows. Each plot consists of three to five rows. The plots are separated with two rows of rye to prevent mixing of strains and varieties. This method appears to give more accurate tests of forage yields and growth characteristics than does the wide-row method.

ANIMAL SCIENCE

W. B. Anthony, Alabama, Presiding

Future trends in dairy cattle feeding - S. P. Marshall

Before discussing the trend in dairy cattle feeding, I should like to mention first other trends in dairying which will influence the trends in feeding.

First, the number of cows per dairy is increasing, and this trend likely will continue. As herd sizes increase, more emphasis will be placed on the application of business principles in the dairy operation. Some of these principles are: specialization, standardization, mechanization, and automation.

Secondly, production per cow will continue to increase. Three factors that will influence continued elevation in production level are: (1) genetic improvement, (2) the continued shift toward the usage of high-producing breeds, and (3) improved feeding and management techniques that will enable dairymen to detect and utilize untapped production potential in many of our present day cattle.

In the future, emphasis will be placed more on a uniform supply of nutritious, palatable forages so that the nutrient intake level of the cattle from this source will be rather constant day by day and month by month. The forage or forages must be (1) uniformly good in quality and acceptability, (2) of dependable supply, and (3) economical. Such a forage program will enable the dairyman to maximize production per cow, eliminate fluctuations in production caused by variations in nutrient intake, standardized feeding practices, and use more mechanization and automation in the feeding program.

A larger proportion of the forage consumed by dairy cattle will be stored forage. There will be a trend toward the use of more stored forage during a larger part of the calendar year. This, of course, means a trend toward more barn, dry lot, and supplemental feeding of forage even on pasture. Although a shift in the direction of confinement feeding is anticipated, this shift will be of deliberate speed. The nature, degree, and speed of this shift toward barn or dry lot feeding will be influenced by a number of factors including forage program, economics, financial resources, managerial ability of management, and future technological developments.

Maintenance of beef cows in drylot and native pasture - P. T. Marion, E. D. Robison and J. K. Riggs

A group of 34 cows have been maintained in drylot on a silage ration since May 1959, and their performance has been compared with 34 similar cows on native pasture. Each group was divided into three lots which were fed a low, medium and high level of energy during the dormant season for native grasses from November to April. These levels of energy were supplied by the following

average daily supplements:

Low level	1.0 lb. cottonseed meal 1.0 lb. sorghum grain
Medium level	0.75 lb. cottonseed meal 2.0 lb. sorghum grain
High level	0.25 lb. cottonseed meal 4.0 lb. sorghum

The cows in drylot were fed 40 to 50 lbs. of sorghum silage per head daily in addition to the above supplements.

The major objective of this study was to determine the effects of the different levels of energy upon the percent calf crop, weaning weights of the calves and longevity of the cows.

Percent calf crop. Four calf crops were weaned which averaged 87, 81, and 91 percent on pasture, and 81, 86, and 92 percent, respectively, for the cows in drylot fed the low, medium, and high levels of energy. There was no significant difference due to the treatment although the high level cows in each group have weaned the highest percentage of calves over the 4-year period.

Weaning weights of calves. Weaning weights on pasture averaged 466, 447, and 462 pounds compared with 489, 488, and 474 pounds for the drylot calves. There was no significant difference due to treatment, but the drylot calves from all three levels of energy averaged 483 pounds compared with 458 pounds for the pasture calves.

The drylot cows seemed to reach maturity earlier, reaching their maximum weight at four years of age, whereas the pasture cows did not reach maximum weight until five years of age. There have been no disease problems with either the cows or calves in drylot. The incidence of cancer-eye has been higher among the cows on pasture than in drylot. After nearly five years in drylot, the cows have not had foot or leg trouble and none of them have had their hooves trimmed. This is probably due to the fact that an exercise pen is provided for the drylot cows, and they have a sloping concrete apron around their feed troughs.

Drylot production of beef calves can become an economical method of production. Feed and labor costs have averaged approximately \$96 per calf, however, with 90 to 120 days of grazing on cultivated pasture during the summer, this cost could be reduced \$15 to \$20 per head. This would make the combination of drylot with temporary pasture production highly competitive with production on native grassland.

The changing pattern of forage production and utilization as viewed by an agronomist - E. M. Evans

The first question that comes to mind concerning this topic is "Is the

pattern really changing significantly?" The previous discussions indicate that there is certainly some degree of change taking place for certain classes of livestock. The outlook is for more change at perhaps an accelerated rate for dairy cattle in particular. A casual glance at almost any farm magazine gives the indication that there is a great push for innovation in all areas of forage production and use. Trade journals extol the virtues of green chopping, random hay bale stacking, gas-tight silo storage, wafering, pelleting, automated feed mixing and so on---and on.

How does an agronomist react to all of this change, or to the promotion in the hope of stimulating change? I'll admit that I view it with mixed emotions--about equal parts optimism and skepticism.

Dr. William Davies, in an address before the Fertilizer Society at the Grassland Research Institute at Hurley in 1958, made a statement as follows: "Pasture grass is a comparatively cheap food for the ruminant and the longer animals can be maintained at grass during the season, therefore, the lower will be costs of production." Now this was not said of the vast plains and prairies but of a tight little island where, I am told, land is so dear it is valued by the pound (sterling, that is). Great Britain plus northern Ireland comprise an area of about 60 million acres. Alabama, just an ordinary sized state, has about 32 million acres. Less than 50 percent of Alabama land falls in land use classes I through IV. If confinement feeding is the trend, then it is not being forced by the scarcity of land.

We may delude ourselves into accepting fanciful, inflated land values appropriate to shopping center or housing development and use these to show that no forage and livestock program can possibly return a profit. The cold fact is that most land in Alabama is farmed as though it had no value at all. This fact may explain the difficulty in promoting pasture development beyond the point where government shares equally in the cost.

From the agronomist's viewpoint, there are certain definite advantages for a program of harvested forages. The problems of overgrazing, fouling and trampling of high-yield grasses and unequal seasonal growth and quality would vanish.

High-producing species not suitable for grazing could be efficiently used. Values of high fertility, difficult to demonstrate under continuous grazing, would become readily apparent. These advantages are all in the direction of intensification.

Some advantages inherent in grazing systems would be lost. Grazing is conservative in terms of plant nutrient requirement with 80 to 85 percent of nitrogen and potassium being returned to the land. The need for plowing is much less with grazing systems and the erosion hazard greatly reduced. Offtake of fertilizer nutrients in large tonnages of harvested forages is especially large. Coastal bermudagrass, for example, fertilized at the 150 lb. rate of N, removed the equivalent of 150 lbs. per acre of N, 66 lbs. P_2O_5 , and 214 lbs. K_2O annually. Replacement of such removal would require fertilizing

at rates sure to frighten many farmers.

Comparative costs of harvested versus grazed forages should be carefully considered. Longstaff reports costs of making Coastal bermuda hay in addition to the costs of growing the crop to be about \$10 per ton. Storage costs and cost of feeding were not included. Auburn University Agricultural economists estimate costs of growing and harvesting Coastal hay to be about \$18 per ton when fertilized at the 200 lb. rate of N.

Capitalization of a harvested feed system requires credit or cash of a new order of magnitude. A fully-automated system jumps the investment to another level. Hoglund at Michigan State University, recently was quoted on the advisability of going to automated system of feeding. He stated that a farmer feeding 200 head of cattle would need to get \$1.60 per hour for the time saved in order to justify the extra \$4,000 investment.

There is no question that the South needs to improve in the area of finishing meat animals if it can do so economically. We annually import one billion pounds each of beef and pork. We have 16% of the country's population and only 3% of its cattle and calves on feed.

It was recently reported (Sears, 20th Conf. Proc. N. Z. Grassland Assoc.) that an American reaching the age of 70 has consumed during his lifetime products equivalent to: 150 cattle, 225 lambs, 26 sheep, 310 pigs, 2,400 chickens, 26 acres of grain, and 50 acres of fruits and vegetables.

The South will have to hurry to capture our fair share of the potential market. The question is whether we can do this more efficiently with "put-and take" or "cut-and-tote" forage systems. Performance data from Alabama experiments do not point to a clear advantage for either system. Dairy cattle at Piedmont substation performed equally well on grazed forage as when confined and fed silage and hay as the roughage source. There was a cost reduction of about 50 cents per hundred lbs. of milk in favor of the grazed roughage system. Steers at the Tennessee Valley Substation lagged in gains on grazing (about 40 lbs.) compared to confined feeding during the growing phase but largely compensated during the finishing period finishing only 5 pounds lighter. Green chop of millet at the Gulf Coast Substation maintained 70% of expected lactation compared to 90% for the grazed forage.

We have a great variety of adapted productive forages available for harvest feed systems but we need the animal scientist to help us determine the value (if any) of grain in sorgo silage, why protein is not digestible in sorgo silage, how much grain is required in corn silage, is the "extra" protein in high-nitrogen Coastal hay of value and if there are measurable quality indicators on these crops that are practical and simple to use as guides to harvesting. If we can get good answers to these and other questions (economic) then we will be in a better position to help guide the changing patterns of forage production and utilization in a rational way.

What can the plant breeder do to produce better and higher yielding forage crops for use in harvested form--A comparative evaluation - Glenn W. Burton

It seems well to begin such an assignment by answering the question, "What has the plant breeder working cooperatively with other agronomists, animal scientists, and engineers done to produce higher yields?" Starting with the native range in the Southeast and moving to pelleted Coastal bermudagrass (Table 1), they have increased per acre yields from 8 to 2270 pounds of live-weight gain.

Feeding harvested forage will give maximum forage yields by permitting us to use non-grazing plant types (tall sugar cane like); harvest to suit the forage, improve forage root reserves, use the environment completely, fertilize heavily, discount seasonal distribution, and use daylength sensitivity to advantage.

Feeding harvested forage will maximize forage utilization by avoiding contamination, avoiding trampling losses, leaving no waste stubble, averaging weather lows and highs, and reducing HCN risks.

Feeding harvested forage will permit better control of forage quality by characterizing quality and quality needs, staging forage more exactly to give the quality needed, supplementing forage and processing it.

Feeding harvested forage will simplify forage breeding by maximizing the importance of yield, simplifying yield measurements, characterizing quality and minimizing the importance of seasonality, grazing tolerance, recovery rate, etc., as breeding objectives.

It seems likely that the sky (light and CO₂) will limit forage production. A theoretical maximum of 180 pounds of dry matter per day has been obtained with Coastal bermudagrass over a 6-week period at Tifton, Georgia. It is believed that the low efficiency (about 4%) with which plants use light can be improved by breeding.

Table 1. Beef production in the Southeastern United States

Pasture and treatment	: Lb./acre
Native range	: 8
Native range burned	: 12
Carpetgrass unfertilized	: 40
Carpetgrass unfertilized + common lespedeza	: 80
Common bermuda not fertilized	: 100
Common bermuda + 36 lb. N + PK	: 140
Coastal bermuda + 36 lb. N + PK	: 260
Coastal bermuda + 200 lb. N + PK	: 680
Coastal bermuda-heavy fertilization-pelleted	: 2270

CROP PHYSIOLOGY-ECOLOGY

C. Y. Ward, Mississippi, Presiding

Utilization of light by forage plants - D. E. McCloud

Forage yields increase until a ceiling is reached in the intensive systems of grassland management. It seems likely that light sets this ceiling on the yield of the newer forage crop varieties. At Beltsville, Maryland, the efficiency of the utilization of solar energy by forage plants is being studied. Previous studies have shown that there is an optimum LAI for maximum rate of dry matter production in plant communities. When this optimum LAI is exceeded, dry matter yields of the community decline, and on the other hand, if the LAI is below optimum, yields decrease. Several studies throughout the world have confirmed this relation, however, there is no information about the behavior of successive layers of leaves within the plant community. Knowledge of photosynthetic and respiratory levels of leaves within the plant community would help agronomists in devising systems to maximize yield, and the plant breeder in tailoring plants for high yields. At Beltsville net photosynthesis of successive 15-cm. leaf layers of pearl millet were measured with an infrared gas analyzer in plant communities with densities of 3 to 36 plants/m² and under light intensities of 1000 to 6000 ft.-c. Leaf area, light interception, leaf angle, photosynthesis and respiration rates were determined for each layer of leafage. Leaf area had a marked influence on light interception over the range of LAI from 1.2 to 15.9, with corresponding light interception of 41 to 100 percent. Leaf angle varied from 46 to 90 degrees and modified the interception of incoming light. Plant density markedly affected net photosynthesis. At 6000 ft.-c. light intensity plants/m² had a net carbon dioxide uptake rate of 5.7 mg. of CO₂/m²/min., while the rate for the 12 plants/m² was the highest at 17.2 mg/m²/min. The highest rate of net photosynthesis for the entire plant community was obtained when the lower most layer of leaves was far below the compensation point. Photosynthesis in the upper leaves more than compensated for the negative growth rate in the lower leaf zones. This is in contrast to some of the work in Australia which indicates that the maximum photosynthetic rate for plant communities is at the point of light compensation for the lower most leaves. This work is continuing to test mathematical models which have been developed in Japan and elsewhere for predicting net photosynthesis of plant communities. It is hoped that results from these studies will contribute to the basic principles of the utilization of light by crop plants, and will be useful to agronomists and plant breeders in raising the ceiling now set on forage yields.

Dry matter and reserve carbohydrate accumulation by forage plants - R. H. Brown

Studies on reserve carbohydrate accumulation by forage grasses have shown a general inverse relationship between growth rate and reserve carbohydrate levels. This relationship has its basis in the energy balance in plants. As long as the demand for energy in new tissue production is high, a surplus of

energy is not likely to occur. If some factor limits growth rate before it limits photosynthesis, then an energy surplus is likely to occur in the form of reserve carbohydrate. If, later, conditions become favorable for rapid growth, the reserve carbohydrate level will tend to decrease.

Some growth regulating factors which tend to cause the inverse relationship between growth rate and reserve carbohydrate in forage grasses are temperature (except above optimum), nitrogen supply, maleic hydrazide (slows cell division - increases water soluble carbohydrate), and soil moisture supply. There are exceptions to this relationship. Certain factors limit growth rate by limiting CO_2 taken into the plant, for example, low light intensity and low CO_2 supply. These factors obviously do not cause a buildup in reserve carbohydrate since energy intake is limited while demand for energy in growth may be high. Temperatures above optimum for plant growth probably cause reduced reserve carbohydrate and slower growth at the same time.

There is evidence that an increase in reserve carbohydrate in plant leaves decreases photosynthetic rate. Slow growth rate or removal of carbohydrate storage organs, such as corn ears, can cause high carbohydrate reserve in leaves. Thus, at times, slow plant growth may limit photosynthesis rather than growth being limited by photosynthesis.

The evidence suggests that storage of reserve carbohydrate is regulated by rate of growth of plants rather than hormonal or auxin control directly.

Subcellular physiology with emphasis on RNA metabolism in plants - S. H. West

Zea mays was germinated and grown under various levels of water stress for periods up to 6 days. The effects of these treatments on growth and some of the basic biochemical processes were observed. At the end of 6 days of growth in a hypertonic solution which imposed 14.7 atmospheres of osmotic pressure fresh and dry weight of seedlings were reduced to one third that in seedlings grown without water stress. In a similar manner amino acid, nucleotide, and protein production was reduced in each seedling by the stress treatment. Contrary to all other constituents measured RNA (ribonucleic acid) increased 20 percent in the seedlings grown in the hypertonic solution. Analyses using P^{32} showed that the increase in total RNA occurred due to an increased synthesis of ribosomes in the stress treated plants.

Specific proteins are required for each of the many hundred chemical reactions that are required for growth. Since all proteins are made essentially from the same 20 or so amino acid, specificity must be a function of the sequence of the building blocks. This carefully regulated sequence of amino acids is thought to be affected by the building block composition of the RNA. In stress treated seedlings the building block (nucleotides) composition of total RNA was unlike that from control seedlings. The relative quantity of GMP plus UMP to GMP plus AMP was twice as high in the stress treated plants as in the control plants.

Three fractions which are important in protein formation are ribosomal, messenger and soluble RNA. Ribosomes constitute 60 to 65 percent of the total RNA in cells and form the template upon which amino acids are finally polymerized into protein. Clusters of ribosomes are more efficient than single units. Some recent data indicate that ribosome clusters are formed

and held together by messenger RNA. In the research reported here ribosomes were isolated and the size of the ribosome units were determined by centrifugation through sucrose density gradients. Plants grown in water stress contained only half as many large aggregates of ribosomes as the control plants. Electron microscope studies verify these data. Radioactive amino acid incorporation into protein was reduced by the stress treatment to about half that of untreated plants. These findings strongly suggest that water stress or drought conditions reduce growth by interfering with the transfer via messenger RNA of nuclear information to the site of protein synthesis.

Interrrelationships of light and temperature on the behavior of crimson clover -
W. E. Knight

In a greenhouse experiment, Dixie, Chief, and Common crimson clover varieties were grown under 9 temperature treatments and under a natural (11 to 14 hours) and 16-hour photoperiod. Additional photoperiod treatments of 8, 14, 18, and 20 hours were provided in a high-night-temperature greenhouse (HN=70°F). A natural photoperiod plus 30 minutes light at midnight was used along with natural, 14-, 16-, and 18-hour photoperiods under low-night-temperature treatment (LN=50°F.).

Crimson clover flowered earlier as length of photoperiod increased. Under long daylengths the plants produced smaller seed heads, fewer leaves, less branching, and greater height than under the shorter photoperiods.

Photoperiodic response in crimson clover is greatly affected by temperature. Earliest flowering occurred when 6 weeks old plants were shifted from cold-frames outside of the greenhouse into the greenhouse with night temperature of 50°F. Shifting 6 weeks old plants from a lower to a higher temperature treatment induced earlier flowering in all cases. High night temperatures inhibited flower production when plants were grown from germination to maturity under the same temperature treatment. A reversal to earliness was found in the late maturing Chief variety grown under high temperature treatments.

A 30-minute break in the dark period did not induce early flowering in crimson clover grown under night temperatures of 50°F. and day temperatures of 70 to 80°F. Plants under this treatment flowered approximately 40 days later than plants under 16-hour photoperiod and 20 days earlier than plants under natural day.

In a field experiment, Chief, Common, and Dixie crimson clover varieties were planted at two week intervals from July 1 to January 1 and at monthly intervals from January until June. The maturity of crimson clover was delayed by 10 days to two weeks for each date of seeding beginning on November 15. The maturity of the December 1, December 15, January 1, February 1, and March 1 seedlings were successively delayed 10 days. Clover seeded in April, May, and June lived through the summer and flowered in April of the following year at the same time as fall seeded clover.

Successful floral induction has been accomplished in crimson clover grown in growth rooms for 8 weeks with night temperatures of 40°F. and day temperature of 50°F. Crimson clover flowered satisfactorily following the low temperature vernalization under a 10 hour day and a temperature regime of 65°F. at night and 75°F. during the day. Vernalization was more effective for the early varieties Frontier and Dixie than on the late variety Chief. The use of low

temperature vernalization in crimson clover will prove quite valuable in crimson clover improvement.

Thursday - April 23 - Morning

Business Session

The concluding business meeting of this conference convened at 11:30 a.m., with Chairman O. C. Ruelke, Presiding. Chairman Ruelke acknowledged the splendid cooperation and help of the program committee, R. E. Blaser, Ian Forbes, Jr., W. B. Anthony, and C. Y. Ward. Appreciation was also expressed to the tours committee, G. B. Killinger, N. W. Silver, and to the staff of the various departments who participated and who were so helpful in making the tours successful. Chairman Ruelke also expressed appreciation to all who helped with the local arrangements, working so diligently on the program, tours, transportation, and the banquet. Chairman Ruelke acknowledged the many contributions of retiring executive committee member, M. S. Offutt, who has been active in the conference for the past several years.

The nominating committee, H. W. Bennett, G. W. Killinger, and R. M. Patterson, Chairman, presented the name of Dr. H. A. Fribourg from Tennessee as nominee for the new executive committee member. It was moved and seconded that the nomination be closed and that the secretary be instructed to cast a unanimous ballot for Dr. Fribourg; motion passed. Following the usual pattern of accession the new elected executive committee member is elevated to Conference Chairman in 1967.

Chairman Ruelke announced that the executive committee had received an invitation from the Tennessee Agricultural Experiment Station inviting the Southern Pasture and Forage Crop Improvement Conference to hold their 1965 meetings in Tennessee. Motion that the University of Tennessee invitation be accepted passed unanimously. June 22 was chosen for the 1965 conference at Nashville, Tennessee, since it precedes the dates for the Second National Grassland Field Day.

Report of Committee on Agronomic Evaluation of Forage Crops and Pastures-The Southern Pasture and Forage Crops Improvement Conference at its meeting in Lexington, Kentucky, in 1957, directed the incoming Chairman of the Conference to appoint a committee to study the agronomic evaluation of forage crops and pastures, and recommend, if possible, a more realistic and meaningful measure of productivity of harvested forages and pastures than dry matter yield per acre. Accordingly, Dr. Pryce Gibson appointed W. B. Anthony, Auburn University; R. E. Blaser, Virginia Polytechnic Institute; H. L. Lucas, N. C. State; M. E. McCullough, Georgia Agricultural Experiment Station; and E. N. Fergus, University of Kentucky, as the committee.

In the seven years that have elapsed since the appointment of this committee, research has provided much information that is applicable to the evaluation of harvested forages in terms that are relevant to their use for feeding or grazing. These terms of measurement include total digestible nutrients, (TDN); digestible dry matter, (DDM); digestible organic matter, (DOM); digestible energy, (DE); net energy, (NE); and nutritive value index, (NVI).

This committee believes that where the animal is not used to measure total production, agronomists can and should begin to compute and report their experimental forage and pasture yields in terms of some such measurement as named above. In fact, it is pertinent to point out that several agricultural colleges, including Alabama, North Carolina, Virginia, Pennsylvania, Massachusetts, and Washington, are now evaluating forages in such manner. True, the purpose in using such a term may be largely for education by agricultural extension but that fact alone points to the need for a more meaningful measure of production than total dry matter, a measure that denotes nothing about chemical composition, digestibility or intake.

This committee accordingly recommends that:

1. Yield data from agronomic forage trials shall be reported both as total dry matter and digestible dry matter.
2. The Regional Committee for Project S-45 (Evaluation of Forage Crops) be urged to make a continuing study of procedures for evaluating forages agronomically with the view of improving on the measures of production previously enumerated.
3. The present committee of the Conference on Agronomic Evaluation of Forage Crops and Pastures be authorized and directed to forward a copy of this report to Dr. J. T. Huber, Chairman of the Regional Committee for Project S-45 and Director George King, Administrative Advisor to the Regional Committee for Project S-45.
4. Upon the completion of recommendation No. 3, this committee shall automatically be dissolved.

Motion that the report of the Committee on Agronomic Evaluation of Forage Crops and Pastures be accepted, passed unanimously.

The resolutions committee, W. E. Knight, C. R. Owen, and T. H. Taylor, Chairman reported as follows:

Be it resolved, the Southern Pasture and Forage Crop Improvement Conference members deeply appreciate the hospitalities extended and facilities furnished them during the twenty-first meeting at the University of Florida. Thanks are especially offered O. Charles Ruelke, local Chairman, University of Florida staff members, and to all conference officers for their part in making this conference a success.

And be it further resolved, the Southern Pasture and Forage Crop Improvement Conference members give special thanks to the program participants for their preparation and presentation of papers. Thanks are especially offered to D. E. McCloud for serving as Secretary and for his efforts in publishing the minutes of the meeting. We move these resolutions be recorded in the minutes of the meeting and a letter of thanks and appreciation be sent to Provost York and local Chairman Ruelke of the host institution.

Report of the resolutions committee was accepted with enthusiastic acclaim by conference members.

Chairman Ruelke expressed his gratitude for the opportunity to work with the group and for all the members who helped make his job much easier. He then turned the meeting over to incoming chairman, Dr. C. Y. Ward, who expressed

appreciation for the entire Southern Pasture and Forage Crop Improvement Conference membership to all of those at Florida for their fine hospitality and the excellent facilities which made this meeting so successful.

Chairman Ward appointed a program committee for the 1965 meeting at Tennessee as follows: R. H. Brown, Virginia; W. C. Johnson, Alabama; and H. A. Fribourg, Tennessee.

Call for business and announcements from the floor yielded no new business. The 1965 Conference Chairman, C. Y. Ward, introduced his executive staff as follows: Past-past Chairman, R. M. Patterson (1965); Past-chairman, O. C. Ruelke (1966); Incoming-chairman, W. B. Anthony (1968); New executive committee member, H. A. Fribourg (1966); Permanent secretary, D. E. McCloud.

In this the 25th Anniversary of the Southern Pasture and Forage Crops Improvement Conference, it seems appropriate to pay tribute to past conference chairmen who have done so much to make this conference enjoyable and enlightening.

<u>Conference Chairman</u>	<u>Location</u>	<u>Date of meeting</u>
R. L. Lovvorn	Tifton, Georgia	July 23-24, 1940
G. W. Burton	Raleigh, North Carolina	July 19-22, 1941
H. R. Albrecht	Lexington, Kentucky	May 23-25, 1946
W. H. Bennett	Gainesville, Florida	April 22-25, 1947
O. E. Sell	State College, Mississippi	June 7-9, 1948
T. J. Smith	Raleigh, North Carolina	June 15-16, 1949
C. R. Owen	College Station, Texas	May 2-4, 1950
G. B. Killinger	Auburn, Alabama	April 17-19, 1951
T. H. Rogers	Baton Rouge, Louisiana	April 24-25, 1952
R. C. Potts	Blacksburg, Virginia	June 11-13, 1953
J. K. Leasure	Stillwater, Oklahoma	June 8-11, 1954
D. S. Chamblee	Knoxville, Tennessee	June 14-16, 1955
R. E. Blaser	Experiment, Georgia	May 15-17, 1956
Wayne Huffina	Lexington, Kentucky	June 11-13, 1957
P. B. Gibson	Clemson, South Carolina	June 4-6, 1958
E. C. Holt	State College, Mississippi	June 9-11, 1959
N. L. Taylor	Fayetteville, Arkansas	June 8-10, 1960
M. E. McCullough	Beltsville, Maryland	June 14-16, 1961
M. S. Offutt	College Station, Texas	June 27-28, 1962
R. M. Patterson	Auburn, Alabama	May 1-2, 1963
O. C. Ruelke	Gainesville, Florida	April 22-23, 1964

REGISTRATION LIST - 1964

Name	State	Address
Anthony, W. B.	Alabama	Ala. Agric. Expt. Station
Clap, J. G.	"	" " " "
Cope, J. T.	"	Auburn University
Donnelly, E. D.	"	Ala. Agric. Expt. Station
Duck, Bobby	"	Auburn University
Ensiminger, E. S.	"	Auburn Potash Institute
Evans, E. M.	"	Ala. Agric. Expt. Station
Johnson, W. C.	"	" " " "
Patterson, R. M.	"	" " " "
Rollins, G. H.	"	Auburn University
Samnerour, C. W.	"	Auburn Potash Institute
Shepherd	"	Auburn University
Wear, John I.	"	Auburn University
Wilson, C. W.	"	Fairfield, U. S. Steel Corp.
Offutt, M. S.	Arkansas	Ark. Agric. Expt. Station
Allen, R. J., Jr.	Florida	Everglades Agr. Expt. Sta.
Ammerman, C. B.	"	University of Florida
Bair, R. A.	"	West Palm Beach
Cacielli, T. E.	"	University of Florida
Cunha, T. J.	"	" " "
Dundven, Leonard	"	" " "
Hammond, L. C.	"	" " "
Harris, H. C.	"	" " "
Hodges, E. M.	"	Range Cattle Station, Ona
Horner, E. S.	"	University of Florida
Hull, F. H.	"	" " "
Hutton, C. E.	"	West Fla. Agr. Expt. Sta., Jay
Jones, D. W.	"	University of Florida
Kirk, W. G.	"	Range Cattle Station, Ona
Killinger, G. B.	"	University of Florida
Kretschmer, A. E.	"	Indian River Expt. Sta., Ft. Pierce
Kuitert, L. C.	"	University of Florida
Linden, D. B.	"	Fla. Agric. Expt. Sta.
Moore, John	"	University of Florida
Prine, G. M.	"	Fla. Agric. Expt. Sta.
Roush, Robert	"	University of Florida
Ruelke, O. C.	"	Fla. Agric. Expt. Sta.
Schank, S. C.	"	" " " "
Schroder, V. N.	"	" " " "
Wallace, A. T.	"	" " " "
Wallace, R. W.	"	North Fla. Expt. Sta., Quincy
West, S. H.	"	Fla. Agric. Expt. Sta.
York, E. T.	"	University of Florida

Name	State	Address
Beaty, E. R.	Georgia	Univ. of Ga., Athens
Brooks, O. L.	"	Southeast Ga. Exp. Sta., Athens
Burns, R. E.	"	Ga. Agr. Expt. Sta.
Burton, G. W.	"	Ga. Coastal Plain Expt. Sta.
Craigsmiles, J. P.	"	Ga. Agr. Expt. Sta.
Elrod, J. M.	"	" " " "
Forbes, Ian, Jr.	"	Ga. Coastal Plain Expt. Sta.
Goins, W. P.	"	Armour Chem. Co.
Hart, R. H.	"	Ga. Coastal Plain Expt. Sta.
Haynesworth	"	Athens
Langford, W. R.	"	Ga. Agr. Expt. Sta.
Luke	"	Ga. Coastal Plain Expt. Sta.
Marchant, W. H.	"	" " " " "
McCullough, M. E.	"	Ga. Agr. Expt. Sta.
Morocock, J. C.	"	Allied Chem Corp, Atlanta
Newton, J. P.	"	Ga. Agr. Expt. Sta.
Powell, J. B.	"	Ga. Coastal Plain Expt. Sta.
Powell, J. D.	"	Ga. Br. Expt. Sta., Americus
Sell, O. E.	"	Ga. Coastal Plain Expt. Sta.
Sist	"	" " " " "
Southwell, B. L.	"	" " " " "
Wells, H. D.	"	" " " " "
Wofford, I. M.	"	Southern Nitr. Co., Savannah
Young, W. C.	"	Univ. of Ga., Athens
Youts, S. E.	"	Decatur
Buckner, R. C.	Kentucky	Univ. of Kentucky
Kendall, W. A.	"	" " "
Stroube, W. H.	"	" " "
Taylor, N. L.	"	" " "
Taylor, T. H.	"	" " "
Templeton, W. C.	"	" " "
Thompson, W. C.	"	Ky. Agr. Expt. Sta.
Woolfolk, P. G.	"	" " " "
Ellzey, H. D.	Louisiana	Southeast La. Expt. Sta.
Mondart, C. L., Jr.	"	La. Agr. Expt. Sta.
Morgan, N. D.	"	Amer. Potash Inst., Shreveport
Owen, C. R.	"	La. Agr. Expt. Sta.
Roark, C. B.	"	" " " "
Hanson, A. A.	Maryland	USDA, Beltsville
D. E. McCloud	"	" "

Name	State	Address
Bennett, H. W.	Mississippi	Miss. Agr. Expt. Sta.
Browning, C. B.	"	" " " "
Knight, W. E.	"	" " " "
Ward, C. Y.	"	Miss. State University
Cope, W. A.	North Carolina	N. C. State College
Gross, H. D.	"	" " " "
Lovvorn, R. L.	"	" " Agr. Expt. Sta.
Murtagh, John	"	" " State College
Timothy, D. H.	"	" " Agr. Expt. Sta.
Bates, R. P.	Oklahoma	Noble Foundation, Box 870, Armore
Elder, W. C.	"	Okla. Agr. Expt. Sta.
Harlan, J. R.	"	" " " "
Huffine, Wayne	"	" " " "
Church, D. C.	Oregon	Oreg. State University
Beinhart, E. G.	South Carolina	S. C. Agr. Expt. Sta.
McClain, E. F.	"	" " " "
Fribourg, H. A.	Tennessee	Tenn. Agr. Expt. Sta.
Gray, Elmer	"	" " " "
Mays, D. A.	"	TVA
Reynolds, J. H.	"	Tenn. Agr. Expt. Sta.
Holt, E. C.	Texas	Texas Agr. Expt. Sta.
Lush, R. H.	"	" " " "
Marion, Paul	"	Texas Sub Station, Spur
Weihing, R. M.	"	Rice-Pasture Expt. Sta.
Vestal, C. K.	"	U. S. Weather Bureau, Ft. Worth
Blaser, R. E.	Virginia	Va. Agr. Expt. Sta., Blacksburg
Brown, R. H.	"	" " " "
Taylor, L. H.	"	" " " "
Garman, W. H.	Washington, D. C.	Nat'l. Plant Food Inst.
Richards, C. R.	"	USDA-SCESS, Washington 25
Ronningen, T. S.	"	" " " "
Thomas, G. W.	"	CSRS
White, F. E.	"	USDA

Report of the
TWENTY-FIRST SOUTHERN PASTURE AND FORAGE CROP
IMPROVEMENT CONFERENCE

University of Florida
Gainesville, Florida

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Agricultural Research Service
Crops Research Division

